SIR ARTHUR LEWIS COMMUNITY COLLEGE

FACULTY OF ENGINEERING

ACADEMIC YEAR (2024/2025) – SEMESTER TWO

END OF SEMESTER EXAMINATION

LECTURER(S)	**:**	**Mr Kwame Frederick**
PROGRAMME TITLE	**:**	**Electrical Installation, Motor Vehicle Mechanics**
COURSE TITLE	**:**	**Engineering Science IIA**
COURSE CODE	**:**	**ENS102**
LEVEL	**:**	**Certificate/Year one**
PAPER	**:**	**One**
DATE	**:**	**Wednesday, 30th April 2025**
COMMENCEMENT TIME	**:**	**1:00 P.M.**
DURATION	**:**	**2 hours**
INVIGILATOR(S)	**:**	**A. Alcindor (Chief),** T. Sandiford, E. Hunte, R. Frederick & N. Fevrier
ROOM(S)	**:**	**CEH-1R-02**
STUDENT ID	**:**	

GENERAL INFORMATION AND INSTRUCTIONS

- This paper consists of Four (4) Sections. **All questions must be attempted on this paper**.
- **Section A** contains Forty (40) Multiple Choice Questions. You are required to answer all questions. One mark is awarded for each correct answer.
- **Section B** contains Five (5) Short Answer Questions. You are required to answer all questions. Marks are awarded accordingly.
- **Section C** contains Five (5) Fill in the Blanks and One (1) Mix & Match question(s). You are required to answer all questions. Marks are awarded accordingly.
- **Section D** contains Four (4) Long Answer Questions. You are required to answer ALL questions. Marks are awarded accordingly
- Students must sign **IN** and **OUT** on the examination class list.
- Students must **not** write their names on their answer sheets, only their ID number.
- Students are reminded to read **all** questions and instructions in each section very carefully.
- Please number your responses accordingly.
- Where you are required to draw to scale FREE HAND SKETCHES will not be accepted.

DO NOT TURN THIS COVER SHEET UNTIL
YOU ARE TOLD TO DO SO!!!

Student ID#_____

SECTION A: Multiple Choice Questions

Answer all questions. (One mark will be awarded for each correct answer)

1. What is the SI unit of heat?
   a) Calorie
   b) Kelvin
   c) Joule
   d) Celsius

2. Which of the following best describes a gas?
   a) Fixed shape and volume
   b) Definite volume but no shape
   c) No fixed shape or volume
   d) Fixed shape but variable volume

3. Which substance is a good conductor of heat?
   a) Wood
   b) Copper
   c) Rubber
   d) Plastic

4. During which phase change is heat absorbed but temperature does not increase?
   a) Melting
   b) Heating
   c) Cooling
   d) Freezing

5. In a heating curve, the flat portions indicate:
   a) Rapid temperature increase
   b) Phase changes
   c) No heat transfer
   d) Chemical reactions

6. What property determines how much a material expands per °C?
   a) Specific heat
   b) Linear expansivity
   c) Heat capacity
   d) Density

7. Plasma is best described as:
   a) A mixture of solids and gases
   b) Super-cooled liquid
   c) Ionized gas
   d) Solidified gas

8. What type of heat transfer does not require a medium?
   a) Conduction
   b) Convection
   c) Radiation
   d) Sublimation

9. Which law states that pressure is inversely proportional to volume?
   a) Charles's Law
   b) Gay-Lussac's Law
   c) Boyle's Law
   d) Newton's Law

10. Which of the following expands the most when heated?
    a) Solid
    b) Liquid
    c) Gas
    d) Plasma

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11. What is the formula for specific heat capacity?
    a) $Q = mc^2$
    b) $Q = mc\Delta T$
    c) $Q = mL$
    d) $Q = \frac{c}{m}$

12. What happens to the particles of a solid when it melts?
    a) They become tightly packed
    b) They gain energy and break free
    c) They lose energy
    d) They stay in place

13. Which instrument measures temperature using two metals?
    a) Mercury thermometer
    b) Thermocouple
    c) Expansion thermometer
    d) Alcohol thermometer

14. A bimetallic strip bends because:
    a) The metals contract equally
    b) It conducts electricity
    c) The metals expand at different rates
    d) It is magnetized

15. What is the latent heat of fusion of ice?
    a) 2,260,000 J/kg
    b) 4,186 J/kg·K
    c) 334,000 J/kg
    d) 81,000 J

16. What is the effect of heating on particles?
    a) They slow down
    b) They stay in place
    c) They move faster
    d) They become cooler

17. Which material is used for lagging hot water pipes?
    a) Copper
    b) Aluminum
    c) Fiberglass
    d) Steel

18. Which phase change skips the liquid phase?
    a) Melting
    b) Sublimation
    c) Condensation
    d) Freezing

19. What property of a surface affects its heat absorption?
    a) Density
    b) Color and texture
    c) Pressure
    d) Volume

20. Which law requires temperature in Kelvin?
    a) Newton’s Law
    b) Charles’s Law
    c) Pascal’s Law
    d) Law of Fusion

21. When water boils, temperature:
    a) Rises rapidly
    b) Decreases
    c) Remains constant
    d) Increases slightly

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22. What unit is used for latent heat?
    a) J/°C
    b) J/kg
    c) J/kg·K
    d) K

23. Which component in a heater resists current to generate heat?
    a) Metal casing
    b) Heating element
    c) Thermostat
    d) Bimetallic strip

24. The boiling point of water in Kelvin is:
    a) 273 K
    b) 300 K
    c) 373 K
    d) 212 K

25. Which statement is true about heat and temperature?
    a) They are the same
    b) Heat is a form of energy; temperature is not
    c) Temperature measures the total energy
    d) Heat is measured in °C

26. What is the correct formula for calculating work in physics?
    a) Work = Power × Time
    b) Work = Mass × Acceleration
    c) Work = Force × Distance
    d) Work = Energy / Time

27. Which of the following is an example of a first-class lever?
    a) Nutcracker
    b) Seesaw
    c) Tweezers
    d) Wheelbarrow

28. Which simple machine changes the direction of a force but does not increase mechanical advantage?
    a) Moveable pulley
    b) Inclined plane
    c) Fixed pulley
    d) Lever

29. The mechanical advantage of an inclined plane is calculated using:
    a) Height / Length
    b) Length × Height
    c) Length / Height
    d) Force / Distance

30. What is a major advantage of a moveable pulley over a fixed pulley?
    a) It changes the direction of the force
    b) It increases speed
    c) It adds mechanical advantage
    d) It requires more force

31. Which class of lever places the effort between the fulcrum and the load?
    a) First-class
    b) Second-class
    c) Third-class
    d) Fourth-class

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32. What does a wedge do?
    a) Increases speed
    b) Increases force and splits or holds material
    c) Reduces mechanical advantage
    d) Converts force into friction

33. Which simple machine is an inclined plane wrapped around a central post?
    a) Wedge
    b) Screw
    c) Pulley
    d) Lever

34. Which of the following best defines power in physics?
    a) The energy stored in a machine
    b) The rate at which work is done
    c) The amount of mass an object has
    d) The resistance a machine overcomes

35. Why can no machine be 100% efficient?
    a) All machines increase energy
    b) Machines are always powered by humans
    c) Some energy is lost due to friction
    d) Machines can't produce mechanical advantage

36. Which of the following statements is true about static friction?
    a) It only occurs when an object is in motion
    b) It is always constant regardless of applied force
    c) It must be overcome to initiate motion
    d) It is lower than sliding friction

37. According to Amontons' laws, frictional force is:
    a) Directly proportional to the surface area
    b) Dependent on the speed of sliding
    c) Independent of the apparent area of contact
    d) Only present in lubricated surfaces

38. Which type of lubrication provides a thick film that completely separates the surfaces?
    a) Boundary lubrication
    b) Mixed lubrication
    c) Hydrodynamic lubrication
    d) Dry lubrication

39. What is the formula for calculating frictional torque on a cylindrical surface?
    a) $T=\mu mg$
    b) $T=\mu Nr$
    c) $T=N\mu r$
    d) $T=\mu Nr$

40. Which bearing type typically has the lowest coefficient of friction?
    a) Dry sliding bearing
    b) Greased journal bearing
    c) Ball bearing
    d) Journal bearing without lubrication

[Total 40 Marks]

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SECTION B: Short Answer Questions.

Answer all questions. (Marks are awarded accordingly

1) Compare and contrast any two states of matter in terms of shape, volume, particle movement, and compressibility. **[6 Marks]**

2) Describe any two of the three methods of heat transfer (conduction, convection, radiation) and provide one example of each. **[6 Marks]**

3) Using a diagram compare and contrast the three classes of levers. Label the position of the fulcrum, effort, and load, and provide one real-life example of each. **[9 Marks]**

FIRST CLASS	SECOND CLASS	THRID CLASS

4) Explain how a heating curve illustrates the process of heating a solid into a gas, including the energy changes that occur in each section of the curve. **[6 Marks]**

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5) Describe how the screw is a variation of the inclined plane. Discuss what about its design makes that true. Explain how it transforms rotational motion into linear force and give practical applications of this simple machine in everyday life. **[5 Marks]**

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[Total 32 Marks]

SECTION C: Fill in the Blanks and Mix & Match Questions

Answer all questions. (Marks are awarded accordingly

[5 Marks]

1. Heat flows from a _____ object to a _____ object until thermal equilibrium is reached.

2. The _____ law explains the relationship between volume and pressure at constant temperature.

3. During melting, the added heat is used to break _____ forces.

4. The unit of specific heat capacity is _____.

5. Dull and black surfaces are _____ absorbers and emitters of heat.

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6. Match the type of change with the example. **[5 Marks]**

Type of Change	Example
Sublimation	Ice turning into water
Melting	Dry ice turning to gas
Condensation	Water vapor forming on glass
Boiling	Water changing to steam
Freezing	Water becoming ice

[Total 10 Marks]

SECTION D: Long Answer Questions

Answer all questions. (Marks are awarded accordingly)

1) A steel rod is 2.00 m long at 20°C. It is heated to 100°C. Given that the coefficient of linear expansion for steel is $1.2 \times 10^{-5}\,°C^{-1}$, calculate: (a) The increase in length of the rod and (b) The final length of the rod. **[4 Marks]**

2) A gas occupies a volume of 300 cm³ at a temperature of 27°C. The temperature is increased to 127°C at constant pressure. Calculate the new volume of the gas. **[5 Marks]**

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3) A gas has an initial volume of 250 cm³ at a pressure of 150 kPa and a temperature of 27°C. The gas is heated to 127°C and the pressure is increased to 300 kPa.Calculate the final volume of the gas. **[6 Marks]**

4) A 2000 g block of metal is heated from 25°C to 75°C. During this process, it absorbs 39,000 J of thermal energy. Calculate the specific heat capacity of the metal. **[3Marks]**

[Total 18 Marks]

Formulas

$$\Delta L = L_0 \times \alpha \times \Delta T$$

$$Q = mc\Delta T$$

$$P_1V_1 = P_2V_2$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2}$$

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END OF EXAMINATION!!